

EPITAXIAL GROWTH AND SPECTROSCOPIC INVESTIGATION OF HEXAVALENT MANGANESE IN BARIUM SULFATE

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Because of their broadband luminescence, TM-ion-doped materials are of high interest for applications as tunable and short-pulse lasers. Systems with a d1 electron configuration possess only one excited 3d level and excited-state absorption into higher-lying 3d levels is impossible. One of these d1 systems, Ti:sapphire has become the most successful tunable and short-pulse laser system to date. Mn⁶⁺ is a promising d1 ion for a tunable laser system. In BaSO₄, near-infrared emission from Mn⁶⁺ was observed. The room-temperature stimulated-emission cross section is larger than the excited-state-absorption cross section in the spectral range 920-1600 nm [1], i.e., as a laser material BaSO₄:Mn⁶⁺ can offer a broad tuning range.

Here we report on the first epitaxial growth of Mn⁶⁺-doped BaSO₄ layers. Growth techniques such as the melt growth fail, because barium sulphate has a phase transition at 1090°C and exhibits thermal decomposition at 1590°C. Therefore, we grew BaSO₄ substrate crystals by the flux method. The Mn⁶⁺ ions tend to reduce to Mn⁵⁺ at $T \geq 620^\circ\text{C}$. We used a CsCl-KCl-NaCl solvent [2] for the LPE of BaSO₄:Mn⁶⁺. This solvent has a low solidification temperature of 480°C and the growth process could be performed at temperatures well below 620°C. The nominal Mn⁶⁺ concentration was up to 0.8 mol%. High quality, lack of large-size inclusions, and low defect concentration were achieved. These Mn⁶⁺-doped BaSO₄ layers were investigated spectroscopically by absorption, emission, and luminescence-excitation measurements at room temperature. Excitation at 800 nm leads to broadband Mn⁶⁺ emission between 850 and 1600 nm. Currently, we investigate the lasing potential of our BaSO₄:Mn⁶⁺ layers.

[1] T.C. Brunold, H.U. Güdel, S. Kück, G. Huber, *JOSA B* **14**, 2373 (1997).

[2] D. Ehrentraut, M. Pollnau, *J. Cryst. Growth* **234**, 533 (2002).